Classification for cleft lip and palate is important for both clinical research and epidemiological investigation and also plays an important role in diagnosis and planning the treatment. Classifications of cleft lip and palate deformities have seen an ocean of changes, each with a different basis for classification, ranging from anatomic and embryologic considerations to the complexity of the deformity. Many newer approaches have also used mathematical expressions to provide a complete description of the deformity including those which can be used for computerized data analysis. This book gives a bird's eye view on the review of past and the most recent classifications and also gives a better understanding of how improvements/advancements in the field have led to a better representation of the various types of cleft deformities.

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Dr. Chetan S is a Professor and Head of the Department of Orthodontics and Dentofacial Orthopedics at Vydehi Institute of Dental Sciences and Research Centre, Whitefield, Bangalore, Karnataka, India.

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Chetan Shankar
Vidya Dhari Kosuri
Rajivi Kalpakuri

CLASSIFICATIONS OF CLEFT LIP AND CLEFT PALATE

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CLASSIFICATIONS OF CLEFT LIP AND CLEFT PALATE

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Dr. Chetan Shankar
Dr. Vidya Dhari Kosuri
Dr. Rajivi Kalpakuri

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General classification

I. In general, 4 categories for organizing cleft palate cases based on the variations of their supposed inheritance patterns:

- Non-syndromic cleft lip with or without cleft palate
- Non-syndromic cleft palate
- Syndromic cleft lip with or without cleft palate
- Syndromic cleft palate

Syndromic types - Associated with other malformations such as the Pierre-Robin Sequence, Treacher-Collins Malformation, Trisomies 13 and 18, Apert's Syndrome, Stickler's Syndrome and Syndrome; more than 300 syndromes have been associated with CLAP. Syndromic aetiologies include single gene transmission such as trisomies; teratogenic causes such as foetal alcohol syndrome; or environmental causes such as amniotic band syndrome or maternal diabetes mellitus.

Non-syndromic CLAP - is a diagnosis of exclusion, and is considered to be of multifactorial inheritance with known predicted rates of recurrence

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II. **Clefts of the palate and lip are also classified as complete or incomplete -**

- Complete clefts of the lip and alveolus involve extension into the anterior nose. Complete clefts of the secondary palate involve both the hard and soft palates with extension into the nose and exposure of the vomer.
- An incomplete cleft has a midline attachment, ranging from a mucosal covering to one with musculature attachment to the midline raphe.

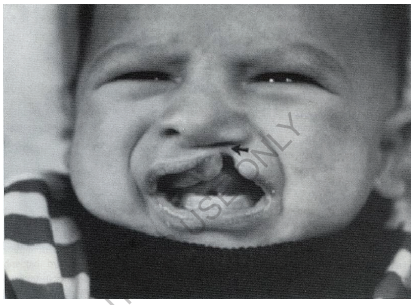
III. **Based on the anatomy of the facial skeleton:**

The Unilateral Cleft Lip -

- The cleft lip is a failure of mesodermal proliferation resulting in complete or incomplete defects.
- The complete unilateral cleft lip includes the orbicularis oris muscle, where the medial portion of the muscle attaches to the columella and the lateral portion to the nasal ala cartilage.

Unilateral Cleft Lip

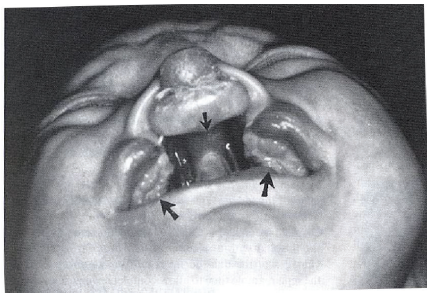
- The medial vermillion border is usually thin (called the white roll).
- An incomplete cleft lip ranges from a mucosal covering to a slight defect in the bulk of the orbicularis muscle which is barely detectable.
- Nasal floor communicates with oral cavity
- Maxilla on cleft side is hypoplastic
- Columella is displaced to normal side



- Nasal ala on cleft side is laterally, posteriorly, and inferiorly displaced
- Lip muscles insert into ala and columella The nasal defect of a unilateral cleft lip is fairly constant.
- The columella is short and often bends and dislocates the septum. The overall appearance is a flattened dome with a wide, horizontal ipsilateral nostril.

The Bilateral Cleft Lip

- The bilateral cleft lip is similar to the unilateral defect with the exception of a complete absence of orbicularis muscle on the medial aspect (the premaxilla or prolabium).
- The prolabium is usually extruded to a varying degree.
- The nasal deformity is essentially a duplication of the unilateral defect, with a bilaterally flattened dome, short columella and bilateral horizontal nostrils.



Clefts of the Primary Palate and Alveolus

- The primary palate is the portion anterior to the incisive foramen. A cleft of the primary palate results in a gap from the incisive foramen through the alveolus.
- Clefts of this type are always associated with clefts of the lip.

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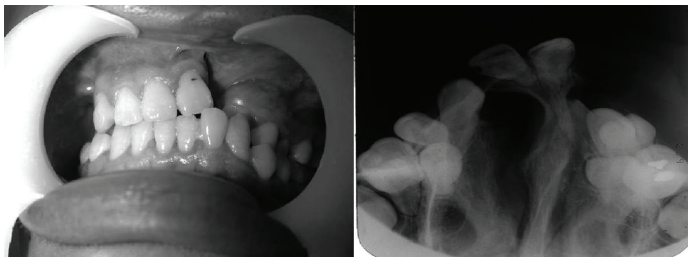
Clefts of the primary hard palate/alveolus

- Cleft lip not necessarily associated with cleft alveolus
- There is opening into nose

CLEFT OF ALVEOLUS



PALATAL CLEFTS

- Soft palate muscles insert on posterior margin of remaining hard palate rather than midline raphe.
- Associated Dental Abnormalities
    - Supernumery Teeth- 20%
    - Dystrophic Teeth- 30%
    - Missing Teeth- 50%
    - Malocclusion- 100%

Clefts of the Secondary Palate

I. Clefts of the secondary palate are a failure of medial growth of the palatal shelves.

II. The defect of the soft palate is failure of midline fusion. The palatal musculature attaches to the posterior hard palate.

III. There are a wide clinical range of clefts of the secondary palate, from the submucous cleft to a complete cleft of the hard and soft palate.

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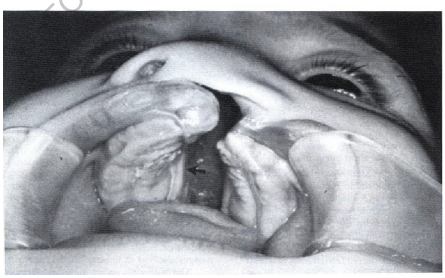
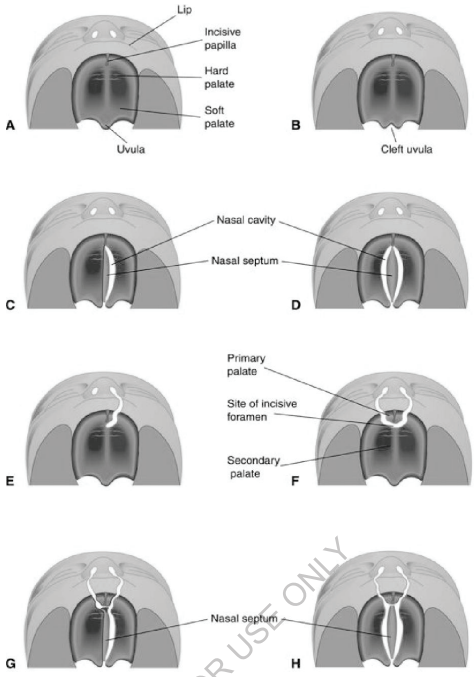


Submucous cleft of the soft palate

IV. The submucous cleft of the soft palate is an extension of the cleft of the secondary palate where mucosa meets in the midline of the soft palate but the velar musculature (levator veli palatini, tensor veli palatini) does not.

V. The classic findings of a submucous cleft include a bifid uvula, absence of musculature attachment to the midline raphe of the soft palate, and a hard palate notch.



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A, **Normal** lip and palate

B,**Cleft uvula.**

C, **Unilateral cleft** of the posterior or secondary palate.

D, **Bilateral cleft** of the posterior palate.

E, **Complete unilateral cleft** of the lip and alveolar process of the maxilla with a unilateral cleft of the anterior or primary palate.

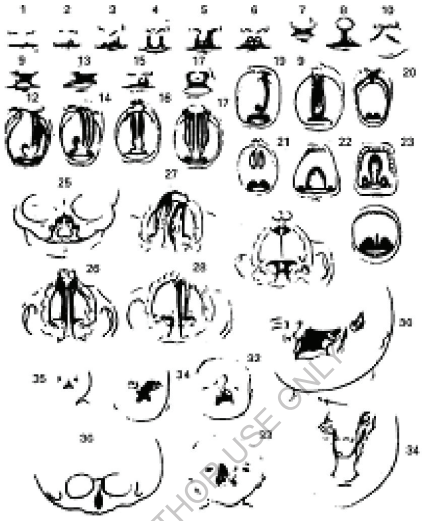
F, **Complete bilateral cleft** of the lip and alveolar processes of the maxillae with bilateral cleft of the anterior palate.

G, **Complete bilateral cleft** of the lip and alveolar processes of the maxillae with **bilateral cleft of the anterior palate and unilateral cleft of the posterior palate**.

H, **Complete bilateral cleft** of the **lip and alveolar processes** of the maxillae with complete bilateral cleft of the **anterior and posterior palate.**

1. Forster classification (1861)[1]

First person to classify malformations of the face was Forster in 1861, a Pathologist from Wurzburg (Germany)



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2. Morians description (1887)[2]

This description of facial clefts was one of the earliest and most accepted classification.

Morian, in 1887, was the first to be credited for presenting a classification for Facial clefts. He described two types, in which the reference was the infraorbital foramen.

• Type I, the oculonasal clefts, in which clefts occupied the region between the infraorbitary foramen and the middle line of the face, and,

• Type II, from the infraorbital foramen to the outer aspect of the face.

- Type 1- (naso-ocular) cleft of the maxilla is between the lateral and central incisor or between lateral incisor and canine.
- Type-2 – (oro-ocular) cleft of maxilla is between incisor and canine.
- Type 3 – (oro-ocular) cleft of maxilla is behind the canine tooth.

3. Sherman (1921)[3]

Sherman in **1921** used four groups in his classification including clefts of lip without concomitant cleft palate.

4. Davis and Ritchies (1922)[4,5,6]

In the United States, Davis and Ritchie presented a classification in 1922

Group I — Cleft lip
Group II – Cleft Palate
Group III -Cleft of both lip and palate

Unilateral, bilateral and median variants o f these three main groups were indicated by further numbers so that a cleft o f the lip unilateral would be group I, 1, a cleft o f the lip median would be group I, 2 and a cleft o f the lip bilateral would be group I, 3. Clefts o f the palate alone, or group II, were subdivided into uvula and soft palate as 1 and hard palate as 2, and each o f these two subgroups was further divided into 1/3, 2/3 and 3/3cleft. Clefts o f lip, alveolus, hard palate and soft palate, or group III, were subdivided into unilateral — group III, 1, median — group III, 2 and bilateral — group III, 3.

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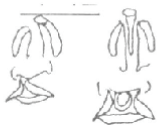
1. Group I – Prealveolar clefts – cleft lip – unilateral
- medial
- bilateral

2. Group II - Post alveolar clefts - Incomplete involvement soft and hard palates, including sub mucous cleft.

3. Group III – Alveolar clefts- complete clefts of both palatal alveolar ridge and lip - unilateral
- medial
- bilateral



Each of the following subgroups is further subdivided into the extent of the cleft (1/3, 1/2, etc).

5. Brophy (1921-1923)[7]

(1921-1923) classified the clefts in 16 distinct morphological forms. However, this was considered too difficult and impractical.

BROPHY		
1.		A very simple form of cleft palate, just a partial cleft of the uvula.
2.		A cleft extending forward into the fibers of the levator palate and the reflected portions of the tensor palate muscles; which gives the absolute anatomic form.
3.		A cleft extending through the uvula and forward to the posterior border of the horizontal plates of the palate bones.
4.		A cleft extending through the entire soft palate, including partial or complete cleft of the horizontal plates of the palate bones.

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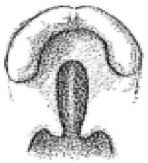
5.		A cleft of the entire soft palate, through the horizontal plates of the palate bones and into the palatal processes of the maxilla.
6.		A cleft of the soft and hard palate nearly as far forward as the line of union between the maxillae and the premaxillae.
7.		A complete single cleft of the entire soft and hard palate, including the alveolar process; the maxilla is separated from the premaxilla, usually on the left side, and accompanied by single harelip.

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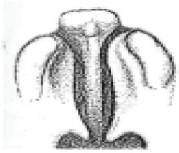
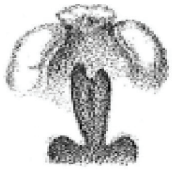
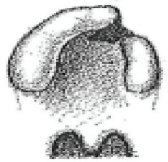
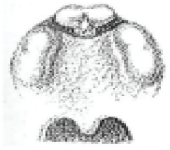
8.		A tripartite cleft, extending through soft and hard palate, separating the premaxillae from the maxillae; nearly always complicated with double harelip.
9.		A cleft of the entire soft palate, extending through the horizontal plates of the palate bones and into, although not through, the palatal plates of the maxillae. (The premaxillae are separated from the maxillae, between which and the anterior part of the cleft, the hard palate is normal; it is usually complicated with double harelip.)
10.		A cleft only between the maxilla and premaxilla, usually on the left side and accompanied by single harelip.
11.		A cleft completely separating the premaxillae from the maxillae, with the palate otherwise normal.

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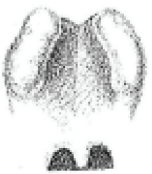
12.		A cleft only of the anterior one half or one third of the hard palate, with protruding premaxillae which are entirely separated from the maxillae.
13.		A cleft of the entire soft and hard palate, extending through the alveolar ridge on one side, with premaxillae separated completely on one side and partially on the other.
14.		A cleft of the soft palate, partial or complete, normal hard palate with cleft in the alveolar border.
15.		A cleft only of the alveolar process anterior to the maxillae, due to the development or absence of the premaxillae, usually accompanied by harelip in the median line.
16.	An exceedingly rare form, a cleft completely separating in the median line the entire palate and lip.	

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6. Veaus (1931)[8]

A) Cleft lip

1. Class I-unilateral and bilateral cleft of the vermillion border not extending into the lip.
2. Class II-unilateral and bilateral notching of vermillion with cleft extending into the lip, but not including the floor of the nose.
3. Class III- unilateral and bilateral clefting of vermillion border, involving lip and extending into the floor of the nose.
4. Class IV-any bilateral cleft of the lip whether incomplete or complete.

B) Cleft palate

Class I- cleft involving only soft palate.

Class II- cleft involving hard and soft palate extending no further than the incisive foramen

Class III- complete unilateral or bilateral cleft extending from uvula to incisive foramen then deviating to one side.

Class IV- complete bilateral cleft similar to class III with two clefts extending forward from the incisive foramen into the alveolus.

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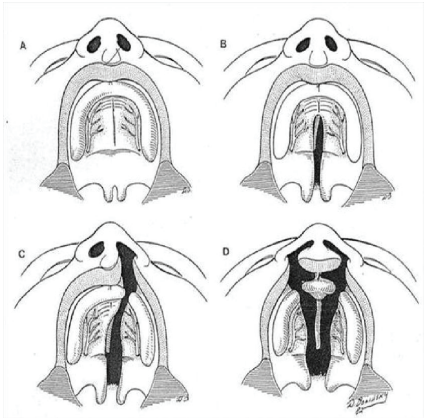

7. Fogh – Anderson (1942)[9]

The embryological approach using the incisive foramen as a landmark was first introduced in 1942 by Fogh-Anderson in Denmark.

Embryological classification

Group 1: Harelip
- Single
- Double

Group 2: Harelip and Cleft palate
- Single
- Double

Group 3: Cleft palate.

8. Pruzansky (1953)[10]

In accordance with the elemental facts of the embryology, anatomy, and physiology of the cleft defect, the varieties of clefts of the lip and palate may be tabulated into four general categories:

1. Those involving the lip alone
2. Those involving the lip and palate,
3. Those in which the palate alone is affected, and
4. Congenital insufficiency of the palate.

The term "palate" will include both the hard palate and the velum,-or soft palate and no special mention is made of the alveolar process in this classification.

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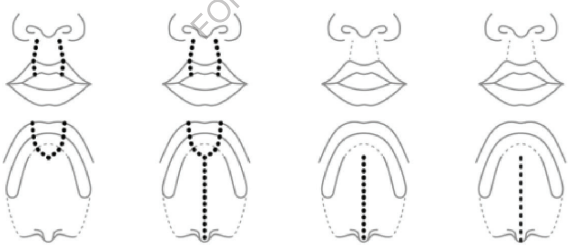

Group 1 Clefts of the lip (and alveolus)

Group 2 Clefts of the lip and palate

Group 3 Clefts of the palate
(includes clefts of the soft palate, clefts of both the soft palate and hard palate, but not the hard palate alone)

Group 4 Congenital insufficienty of the palate
(includes submucous clefts and deficient palatal development)

9. Kernahan and Starks Classification (1958)[11]

Kernahan and Stark in **1958** were for the first time struck by the idea of the importance of classification based on embryology unlike previous classifications based on morphological features. They took the incisive foramen or papilla as the dividing point between the primary and secondary palate. This classification divided clefts into three groups: clefts of primary palate, clefts of secondary palate and clefts of both primary and secondary palate.

A) Cleft of primary palate only
- ❖ Unilateral
  - ➢ Total/Complete
  - ➢ Subtotal/Incomplete
- ❖ Median
  - ➢ Total/Complete (Premaxilla absent)
  - ➢ Subtotal/Incomplete (Premaxilla rudimentary)
- ❖ Bilateral
  - ➢ Total/Complete
  - ➢ Subtotal/Incomplete

B) Cleft of secondary palate only
- ❖ Total/Complete
- ❖ Subtotal/Incomplete
- ❖ Submucous

C) Cleft involving both primary and secondary palate.
- ❖ Unilateral
  - o Total
  - o Subtotal
- ❖ Median
  - o Total
  - o Subtotal
- ❖ Bilateral
  - o Total
  - o Subtotal

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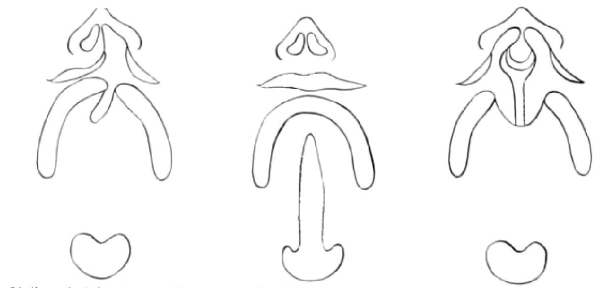
(Primary Palate – anterior to incisive foramen include lips and premaxilla secondary palate – posterior to incisive foramen.)- Best available classification today.



10. Harkins (1960)[12]

Harkins et al in **1960** proposed a morphological classification of cleft lip and palate. This classification had two major groups, each group with two sub-groups. Two major groups are pre-palate and palate. Pre-palate is further divided into two groups, lip and alveolar process to incisive foramen. Palate is further divided into soft palate and hard palate to incisive foramen. Comparatively, it was the most comprehensive classification system of that time, which made provisions for describing the location (right, left and median), extent (1/3, 2/3, 3/3) and width of the cleft.

11. Vilar-Sancho (1962)[13]

Classified and coded them based on Greek nomenclature. Lip was represented by "K" (keilos), alveolus by "G" (gnato), hard palate by "U" (urano) and soft palate by "S" (stafilos). Complete cleft was represented in capitals and partial in small letters. "2" was used to represent bilateral, "d" indicated right, "l" indicated left, an "I" indicated incomplete and "o" indicated operated. Being in Greek, it could not be adapted by the rest of the world. It also could not classify many of the clefts.

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KI GI UIS SK

12. American cleft palate association's classification- Harkins and associates (1962)[14]

Harkins et al. were appointed by American cleft palate association (ACPA) to design a classification of CLP. They proposed a classification in six groups based on the concept of Kernahan and Stark. This included rare clefts along with the usual clefts. Harkins et al. divided the groups further based on the extent and sides.

1. Cleft of Primary Palate
A. Cleft Lip
(1) Unilateral: right, left (a) Extent: one-third, two-thirds, complete
(2) Bilateral: (a) Extent: one-third, two-thirds, complete
(3) Median (a) Extent: one-third, two-thirds, complete
(4) Prolabium: small, medium, large
(5) Congenital scar: right, left, median (a) Extent: one-third, two-thirds, complete
B. Cleft of Alveolar Process
(1) Unilateral: right, left (a) Extent: one-third, two-thirds, complete
(2) Bilateral: (a) Extent: one-third, two-thirds, complete
(3) Median (a) Extent: one-third, two-thirds, complete
(4) Submucous: right, left, median
(5) Absent incisor tooth
2. Cleft of Palate
A. Soft Palate
(1) Posteroanterior: one-third, two-thirds, complete
(2) Width - maximum (mm)
(3) Palatal shortness: none, slight, moderate, marked
(4) Submucous cleft (a) Extent: one-third, two-thirds, complete
B. Hard Palate
(1) Posteroanterior (a) Extent: one-third, two-thirds, complete
(2) Width - maximum (mm)
(3) Vomer attachment: right, left, absent
(4) Submucous cleft (a) Extent: one-third, two-thirds, complete
3. Mandibular Process Clefts
A. Lip (a) Extent: one-third, two-thirds, complete
B. Mandible (a) Extent: one-third, two-thirds, complete
C. Lip Pits: Congenital lip sinuses
4. Naso-ocular: Extending from the narial region toward the medial canthal region.
5. Oro-ocular: Extending from the angle of the mouth toward the palpebral fissure.
6. Oro-aural: Extending from the angle of the mouth toward the auricle.

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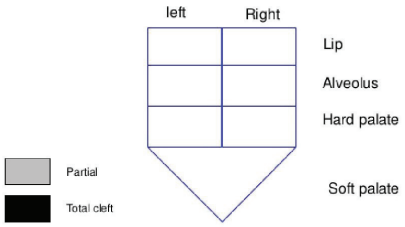
13. Schuchardt and Pfeifer's symbolic classification (1966)[15]

- This classification makes use of a chart, made up of a vertical block of three pairs of rectangles with an inverted triangle at the bottom.
- The inverted triangle represents the soft palate while the rectangles represent the lip, alveolus and the hard palate as we go down. Areas affected by clefts are shaded on the chart.



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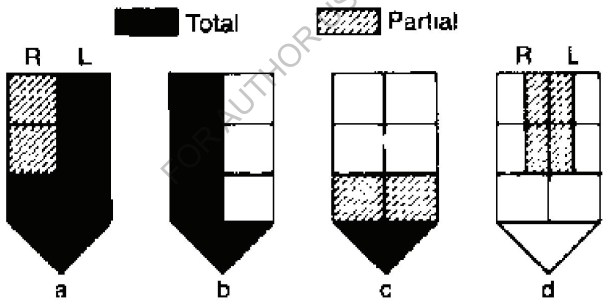

Pfeifer's original illustrations of his contribution during the second International Symposium, Hamburg. (From : Schuchardt K, editor. Treatment of Patients with Clefts of Lip, Alveolus and Palate. Stuttgart, Thieme 1966. The median cleft lip and premaxilla does not fit into Pfeifer's morphogenetic scheme and was added on the recommendation of the American Cleft Palate Association at that time.

14. International Confederation for plastic and reconstructive surgery (IPRS) - (1969)

By Broadbent et al
Embryological classification.

Group 1: Clefts of anterior (primary) palate
- a. Lip – right and/or left
- b. Alveolar – right and/or left.

Group 2: Cleft of anterior and posterior palate.
- a. Lip – right and/or left
- b. Alveolar – right and/or left
- c. Hard palate – right and/or left.

Group 3: Clefts of posterior (Secondary) palate
- a. Hard palate - right and/or left
- b. Soft palate - median.

For further subdivisions the terms total and partial should be used

Rare facial clefts
Classification based on topographical findings
a) Median clefts of upper lip with or without hypoplasia or
b) Aplasia of premaxilla
c) Oblique clefts oro-orbital
d) Transverse clefts oro-auricular
e) Clefts of lower lip nose and other very rare clefts

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15. Arturo Santiago classification (1969)[16]

Santiago A proposed a classification in **1969** in which he used four digits to indicate presence of cleft and its location. Each digit is followed by letter to indicate condition of cleft (complete, incomplete or sub mucous).

Four digits represent the following four structures affected by cleft.
- The first digit refers to the lip.
- The second digit refers to the alveolus.
- The third digit refers to the hard palate.
- The fourth digit refers to the soft palate.

The numbers used as digits represents the condition of cleft.
- 0= No cleft
- 1= Midline cleft
- 2= Cleft on right side
- 3= Cleft on left side
- 4= Bilateral cleft

The letters indicate more specifically the type of cleft.
- A = An incomplete midline cleft
- B = An incomplete cleft of right side
- C = An incomplete cleft of left side
- D = Bilateral incomplete cleft
- E = Sub mucous cleft

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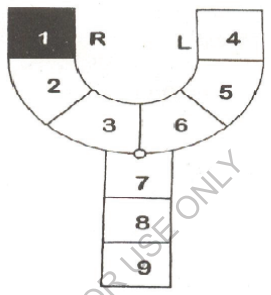
Points to consider when using the Arturo Santiago Classification System:
- When a cleft is not described that it is complete or incomplete, it is always assumed as complete cleft.
- When clefts of lip, hard and soft palate are described without giving any information about alveolus, it is assumed that it is completely affected by cleft.
- All cases will be considered midline cleft unless otherwise specified.

16. Dahl (1970)[17]

Divided the clefts in four groups: CL, cleft palate (CP), and unilateral CLP and bilateral CLP.

17. Kernahans striped Y logo classification (1970)[18]

Kernahan in **1971** converted his previous embryologically based classification of 1958 from descriptive format into symbolic representation (known as "Striped Y"). It gained more popularity than previous one because of its self explanatory and easy delineation. However, there were some shortcomings, i.e. the degree of cleft lip cannot be properly shown, premaxillary protrusion, alveolar arch collapse and velopharyngeal incompetence cannot be depicted.



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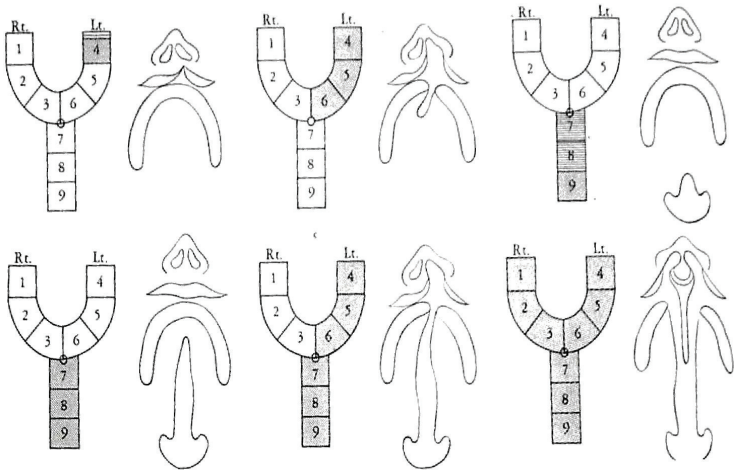
This classification highlights the anatomic and embryonic importance of the incisive foramen formed during weeks 4-7 GA. The secondary palate forms the roof of the mouth from the incisive foramen to the uvula during weeks 7-12 GA.

This system provides a graphic classification scheme using a Y-configuration, which can be divided into 9 areas/blocks

In this classification incisive foramen is the reference point and it is based on embryology rather than morphology.

The two arms of the stripes Y Logo are each divided into three sections, representing the lip, the alveolus, and the hard palate as far back as the incisive foramen. The stem of Y is also divided into three parts, representing varying degrees of clefting of the hard and soft palates. Over clefting is represented by stippling and submucous clefting by cross-hatching.

- **Block 1 and 4** - Lip
- **Block 2 and 5** - Alveolus
- **Block 3 and 6** - Hard palate anterior to the incisive foramen
- **Block 7 and 8** - Hard palate posterior to incisive foramen
- **Block 9** - Soft palate



The boxes are shaded in areas where the cleft has occurred.

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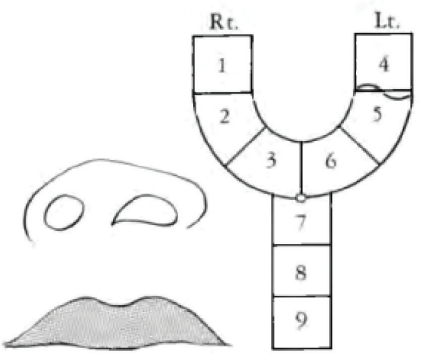
18. Kernahan's 'Lasy S' [19]

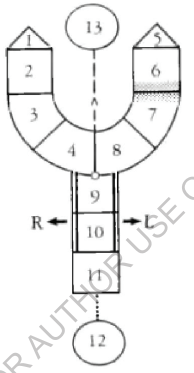
Khoo Boo-Chai of Singapore, aided and abetted by Ichiro Tange o f Tokyo, conjured up a new clinical subgroup o f the cleft lip deformity, that of the isolated cleft lip nose, which they suggested must be included in any comprehensive classification along with the usual minimal cleft lip with congenital scar. Kernahan was quizzed on this point and he suggested that the isolated cleft lip nose be indicated on the Y as a lazy S at the junction o f the lip and alveolar segments.



19. Elsahy's classification (1973)[20]

Egyptian Nabil Elsahy in **1973** modified Kernahan's Striped Y classification by including more details. His classification described degree of cleft lip, collapse of the alveolar arch, displacement of palatal segments, state of velopha-ryngeal closure, absence or presence of protruding premaxilla and degree of pre-maxillary protrusion. This classification is modification of Stripped "Y" classification.

Elsahy modified the stripped Y by further double lining the blocks 9 and 10 in the hard palate area and used arrows to indicate the direction of deflection in complete clefts. He also placed a circle 12 under the stem of the Y to represent the pharynx and a dotted line from the Y to circle 12 reflecting the velopharyngeal competence. Another circle 13 was also added to represent the premaxilla, and the amount of its protrusion was indicated by dotted line with an arrow.



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20. Spinas Classification (1974)[21]

1974- modified the ACPA classification with incisive foramen as a reference point.[19]

Group I- preincisive foramen cleft
Group II-transinsive foramen cleft.
Group III- post incisive foramen cleft.
Group IV- rare facial clefts.

Each group had unilateral, bilateral and median; each was further subdivided into total and partial. This was adapted by the International Society for Plastic and Reconstructive Surgery.

21. C Balakrishnan-Nagpur classification (1975)[22]

An Indian classification of Cleft Lip and Palate defects.

Cleft type	Abbreviation
Cleft lip	Gp 1
Cleft palate	Gp 2
Cleft lip, alveolus and palate	Gp 3
Right	R
Left	L
Midline	M
Alveolus	A
Partial	P
Submucosal	S
Simonart's band	sb
Microform	micro

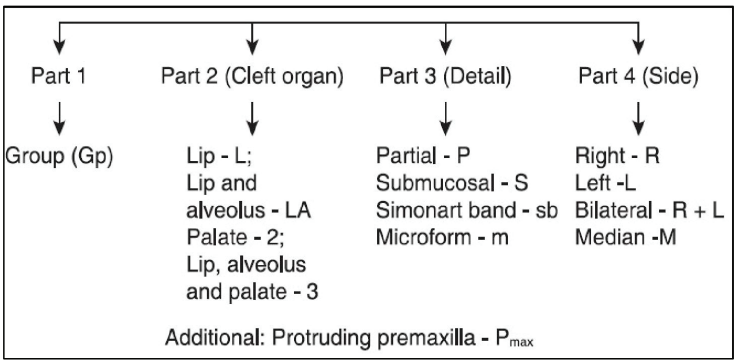
Using these groups and brief notations, he described 12 types of possible cleft deformities. Sixteen possible intergroup combinations in a series of over 1000 cleft patients have been described.

Cleft Lip only (Gp. 1); Cleft Lip and Alveolus (Gp. 1-A); Cleft Palate only (Gp. 2); Cleft Lip and Palate (Gp. 3). To each of these groups, the side of the cleft (L or R) was added in unilateral cases while bilateral cases had the notation L,R.

CO-AUTHOR USE ONLY

Group 1 - cleft lip only
Group 1A - cleft lip and alveolus
Group 2 - cleft palate only
Group 3 - cleft lip and palate

CLA Gp 1A- L | UCLP(L) Gp III-L | BCLP Gp III-L, R | CP Gp II



22. Bixler (1975)[23]

divides oral clefts into three groups which are represented by

1. **Syndromic**, which includes monogenic (single-gene disorders), chromosomal, and environmental aetiologies. Syndromic accounts for 1 % of cleft lip or cleft palates and 8% of isolated cleft palates.

Chromosomal disorders: trisomy 13, trisomy 18, Turner syndrome, Down syndrome

Monogenic syndromes: Van der Woude syndrome, Apert syndrome, Oral-facial-digital syndrome I, Treacher Collins syndrome.

2. **Familial** includes those with two or more affected individuals in first, second or third degree relatives. Familial accounts for 25% of cleft lip/cleft palates and 12% of isolated cleft palates. Efforts are ongoing to locate specific susceptibility genes in the non-syndromic familial cases, with TGF α, TGFβ3, MSX1, and loci at 6p23-p24, and Xcen-Xq21 being a few that have been identified in some families.
3. **Isolated or nonfamilial**, which includes all kindreds with only the proband (ie, the first person in a pedigree found to have the defect) affected in first, second, and third degree relatives. This group accounts for 75% of cleft lip/cleft palates and 80% of isolated cleft palate cases.[21]

FOR AUTHOR USE ONLY

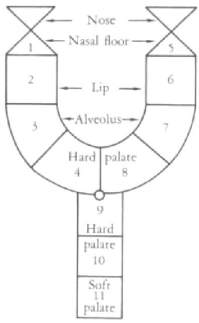
23. Tessier (1976)[24]

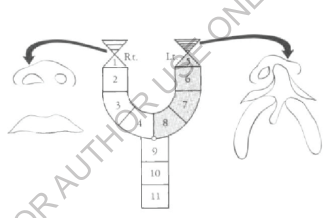
In **1976**, Tessier proposed a classification system for facial clefts in which he described 14 different types of clefts according to their location in relation to eye and orbit. Clefts of lip, alveolus and palate were numbered 1, 2 and 3.

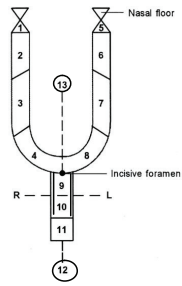
24. Millard's Classification (1977)[25]

Millard in 1977 further modified the Elsahy striped Y by adding inverted triangles atop the upright triangular segments 1 and 5 to stand for the right and left aspects of the nasal arch. This revised classification received considerable fame amongst surgeons.
Millard's symbolic representation is basically a modification of Kernahan's striped 'Y' classification. He has added inverted triangles atop the upright triangular segment which in turn stand on the 'Y' proposed by Kernahan. The inverted triangles represent the nasal arch and the upright triangles represent the nasal floor.

Modified Y is being used in this volume as a simple preoperative case record. The Y will be capped with triangular peaks for the nasal floor, and these will be topped with similar triangular peaks turned upside down to represent the nasal arch. To indicate a cleft the area will be stippled, to indicate submucosal muscle and bony clefts, the area will be marked with horizontal lines, and to indicate the degree o f nasal deformity the top triangle will be lined horizontally in density proportionate to the severity o f the distortion.







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25. Berlin classification (1979)[26]

3 groups.

Group1 – Cleft of anterior palate
Group2 – Cleft of anterior and posterior palate
Group3 – Cleft of posterior palate rare clefts

26. Sandham (1985)[27]

Added type 5 as "other types of clefts" over Dahl's proposed classification.[25]

27. LAHSHAL Classification (1987)[28]

This was formulated by O Kriens in 1987. LAHSHAL is a paraphrase of the anatomical areas affected by the cleft.[26]

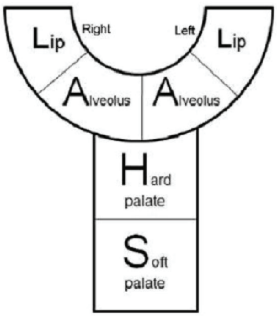
- **L - LIP**
- **A - ALVEOLUS**
- **H – HARD PALATE**
- **S – SOFT PALATE**
- **H – HARD PALATE**
- **A – ALVEOLUS**
- **L – LIP**

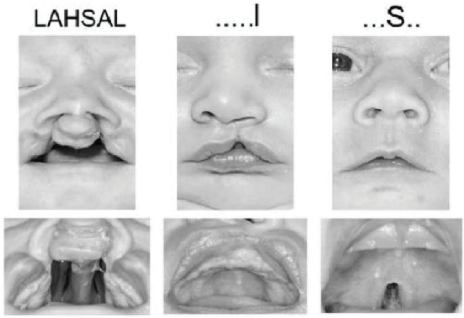
This classification is based on the premise that clefts of lip, alveolus and hard palate can be bilateral while clefts involving the soft palate are usually unilateral. The areas involved in the cleft are denoted by the specific alphabet standing for it.
For eg: LAH stand for cleft of right lip, alveolus and hard palate and LAHS-L stand for cleft for right lip, alveolus, hard palate and soft palate together with left cleft lip.

It also includes 3 degrees - complete, microform, partial (lahshal) eg: lahSh.. Partial right lip and alveolus cleft associated with a complete velar cleft extending into the hard palate, LahSHAL complete right lip and partial alveolus cleft associated with a complete left unilateral CLAP extending into the hard palate on the right side.

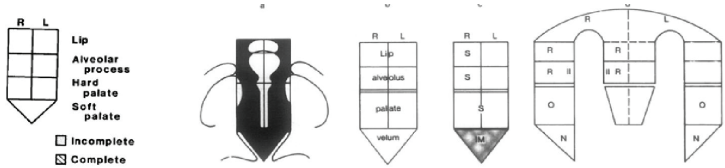
Later, it was modified to "LAHSAL" on the recommendation of Royal College of Surgeons UK in 2005 by omitting one "H" from the acronym "LAHSHAL".[27]

FOR USE ONLY





28. Modification of Symbolic representation of Pfeiffer 1966 - 1987



In 1964 Pfeiffer introduced symbolic representation of cleft lip and cleft palate at the 2nd International Symposia on Cleft Lip and Palate in Hamburg. It is a pentagon that consists of a lip, alveolus, and hard palate standing on top of a triangle representing the soft palate. In 1987, Pfeifer introduced another diagram that enables one not only to represent the cleft but also the surroundings of the cleft malformation. Both diagrams are easy to use, but they did not consider the malformed nose and Vomer.

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29. Modification of Tessier's cleft classification system (1989) [29]

This system uses the orbit as the frame of reference and the clefts are based around this axis A broad classification is one proposed by Tessier utilizing a clockface analogy from 0 to 14. The point of reference for these clefts is the orbit with the clefts found in two different hemispheres. Those of the lower lid region are facial, while those of the upper lid are cranial. Clefts 0 through 4 have extensions downward to involve the maxilla and fit into the usual cleft lip and palate classifications. Their superior extensions are the more severe major cranial anomalies.

A. Basic Considerations
   1. The point of reference is the orbit with the clefts found in two different hemispheres.
      a. Those of the lower lid are classified as facial clefts
      b. Those of the upper lid are classified as cranial clefts
      c. Combined or craniofacial clefts may occur
   2. This system describes both the surface and underlying bony anatomy.
   3. The extent of involvement of soft and bony tissue is variable.

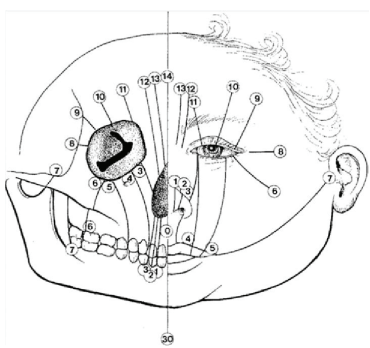
B. The Classification

CENTRIC

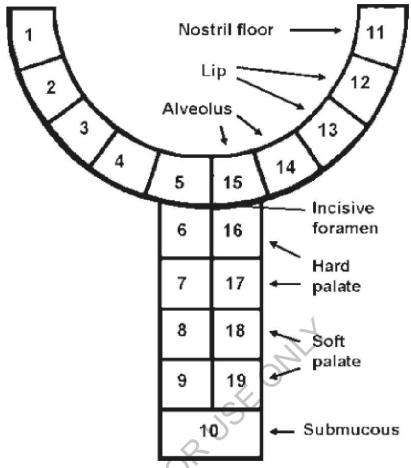
Facial Clefts	Corresponding Cranial Extension of Facial Clefts
No. 0	No. 14
No. 1	No. 13
No. 2	No. 12
No. 3	No. 11

ACENTRIC

Facial Clefts	Cranial Clefts
No. 4	No. 10
No. 5	No. 9
No. 6	
No. 7	
No. 8	



30. Double-Y numbered - Noordhoff (1990) [30]



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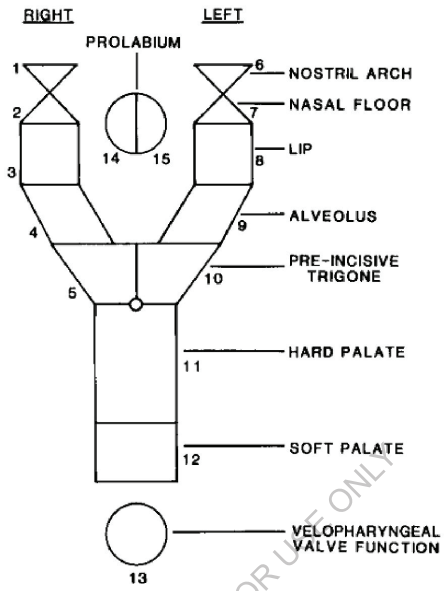
The double-Y numbered classification. The numbers 1 to 9 represent the right side of the cleft and the numbers 11 to 19 represent the left side of the cleft. The number 10 represents a submucous cleft palate. It more accurately defines the nature of the clefts on either or both sides of the primary palate, 1 to 9 (or 11–19) as well as either or both sides of the secondary palate, 16 to 19 (6–9) or any combination.

31. Iowa Classification (1990)[31]

- a variation of Veau Classification
By - Hanson and Murray, **1990**

Group I -	clefts of lip only - These are defined as clefts of the lip only
Group II -	clefts of palate only - These are defined as clefts of the palate only i.e. secondary palatal clefts
Group III -	clefts of lip, alveolus and palate - These are defined as clefts of the lip , alveolus and palate i.e. complete cleft lip and palate.
Group IV -	clefts of the lip and alveolus - These are defined as clefts of the lip and alveolus i.e. primary cleft palate and lip
Group V -	miscellaneous - includes clefts which do not fit into any of the above categories.

32. Friedman (1991)[32]



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FRIEDMAN'S CODING INSTRUCTIONS

STEP I:

This step includes the depiction of the deformity of the nasal arches (triangles 1 and 6) and nasal floors (triangles 2 and 7). In each triangular space, defect is recorded in the following manner.

0 = No involvement
1 = Cleft microform (e.g; notching)
2 = Mild deformity (i.e; some actual tissue deficiency)
3 = Moderate deformity
4 = Severe deformity
X = Not rated

STEP II:

It includes the depiction of the amount of prolabium or pre-maxillary protrusion on one or both sides (semi circles 14 and 15).

0 = No protrusion
1 = Mild protrusion (<45p)
2 = Moderate protrusion (>45p ,<90p)
3 = Severe protrusion (>90p)
X = Not rated

STEP III:
This step depicts the upper lip deformity.
0 = No involvement
1 = Cleft microform
1a = Congenital scar in usual cleft position (subcutaneous cleft)
1b = Notch in the vermillion border
2 = 1/3 cleft lip (cleft in vertical dimension)
3 = 2/3cleft lip (cleft in vertical dimension)
4 = Complete cleft lip
X = Not rated

STEP IV:
It shows the defect in the alveolus.
0 = No involvement
1 = Cleft microform
1a = Submucous cleft
1b = Notch
2 = Partial cleft
3 = Complete cleft
3a = Absence of maxillary arch collapse
3b = Presence of maxillary arch collapse
X = Not rated

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STEP V:
It represents the pre-incisive foramena trigones.
0 = No involvement
1= Partial cleft
2= Complete cleft
X= Not rated.

STEP VI:
It describes the anatomy of the hard palate
0 = No involvement
1 = Posterior 1/3 cleft
2 = Posterior 2/3 cleft
3 = Complete cleft X = Not rated.

STEP VII:
It indicates a defect in the soft palate or velum including uvula.
0 = No involvement
1= Cleft microform of uvula
1a = Hypoplasia of musculus uvulae
1b = Septate uvula
1c = Bifid uvula
2 = Submucous cleft of velum
2a = Occult
2b = Overt
3= Posterior 1/3of velum
4= Posterior 2/3 of velum
5 = Complete cleft of velum

X = Not rated.

STEP VIII:
It represents velopharyngeal valve dysfunction
0 = No impairment
1 = Mild impairment
2 = Moderate impairment
3 = Severe impairment
X = Not rated

33. Friedman and Schwartz (1993)[33]

Classified clefts through RPL system **1993**

- This system is based on the Kernahan Y classification and classifies clefts using three digits (one on left side of Y, another for the right side and a third for the base of Y). Each digit assumes a value between 1 & 3, reflecting the number of affected components in each limb of Y.

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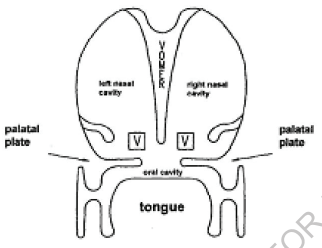
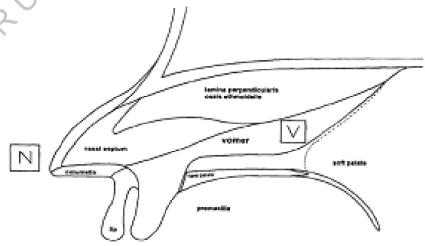
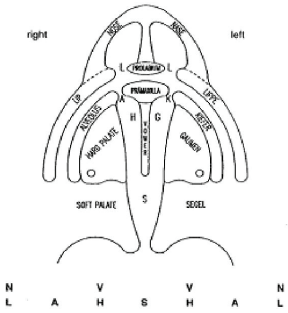
34. Koch and Koch (1995)[34]

In **1995** Koch and Koch proposed a new extended classification, LAHSN of cleft deformities. In addition to the lip, alveolus, hard palate, soft palate, they also considered the Vomer and the micro forms in three dimensions. The anatomical regions-lip, alveolus, hard and soft palate, and nose (LAHSN) can be affected single, or they can be affected in all combinations with each other. The severity of all single and combined malformations of LAHSN depends on its extent in sagittal, transverse and vertical directions, and it depends on whether they are submucous or open forms. For a better estimation of the severity, and for a description of the real extent of a cleft, we think, it is necessary to have a gradation for each cleft region. A classification considering this should have the same gradation for each region and be applicable to all the various types of clefts. It must satisfy the clinical demands, be reproducible, and be simple. Since the severity of a cleft malformation depends on its extent in transverse, vertical and sagittal direction and its shape-whether it is an open or submucous form, this has to be considered when a cleft diagnosis is going to be recorded.







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35. US Classification (1995)[35]

(Prenatal ultrasonographic (US) classification of cleft lip with or without cleft palate (CL-P) David A. Nyberg,G. Kimberly Sickler,Frederick N. Hegge, Dawna J. Kramer, Robert J. Kropp,: Fetal Cleft Lip with and without Cleft Palate: US Classification and Correlation with Outcome: Radiology 1995; 195:677-684).

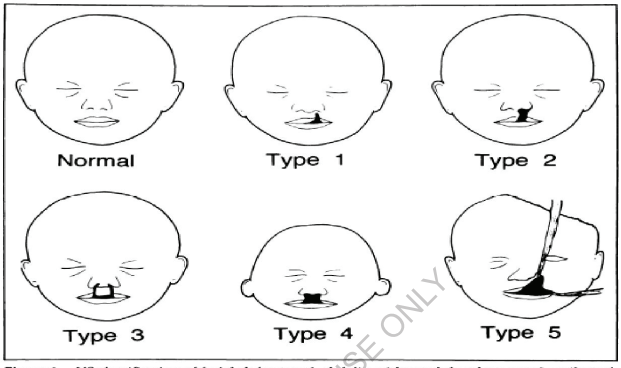

Figure 1. US classification of facial clefts: *type 1*, cleft lip without cleft palate; *type 2*, unilateral cleft lip and palate; *type 3*, bilateral cleft lip and palate; *type 4*, midline cleft lip and palate; and *type 5*, cleft associated with amniotic bands or limb–body-wall complex.

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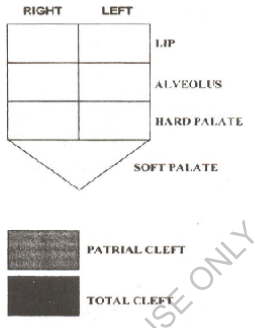
36. Morteir - a dual scale-Schuchardt and Pfeifer's symbolic classification (1997)[36]

- Corresponding to the severity of the cleft (ISS or initial severity score).
- Related to the surgical result (PRS or postoperative result score).
- A comparison of the ISS & PRS allows for more objective assesment of the surgical result. However, it has been applied only to unilateral incomplete clefts of the primary palate.



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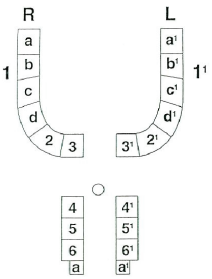
37. Smith - A modification of the Kernahan "Y" classification in cleft lip and palate deformities (1998)[37]

1. All right-sided clefts are designated by numerals without prime and left-sided clefts by numerals that are primed. For example, **1** means a complete right cleft lip and **1′** means a complete left cleft lip.
2. Incomplete cleft lips vary from microform to one-third to two-thirds, and these are classified as **a–c** and **a′–c′** for right and left, respectively. Lips with Simonart's band are classified as **d.**
3. The alveolus is documented as **2** or **2′.** No allowance is made for minor degrees of clefting of the alveolus, as this has little bearing on management.
4. The palate anterior to the incisive foramen and posterior to the alveolus is documented as **3** or **3′.**
5. The secondary palate, lying posterior to the incisive foramen, is subdivided into three segments based on the anatomic segments involved in the cleft. **4** denotes a cleft up to the palatine process of the maxillary bone, **5** is a cleft up to the palatine process of the palatine bone, **6** is a cleft including the soft palate only, and the letter **a** denotes a submucous cleft.



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38. Read and International Classification of Diseases (ICD) codes

For cleft lip and palate anomaly:

A number of classifications exist but, given the wide variation in clinical presentation, in practice it is often preferable to describe the presenting deformity in words. However, in medicine in general, moves to standardize nomenclature have resulted in the introduction of national and international classifications which aim to embrace all medical conditions, thus facilitating epidemiology and management. Of these, the most widely accepted in the UK is the Read coding system.

Codes for cleft lip and palate anomalies

Anomaly	Read	ICD
Cleft lip + palate (unspecified)	P9	749
Cleft lip	P91	749.1
Cleft palate	P90	749.0
Cleft lip + palate	P92	749.2
Unilateral complete cleft lip + palate	P921	749.21
Bilateral complete cleft lip + palate	P923	749.23

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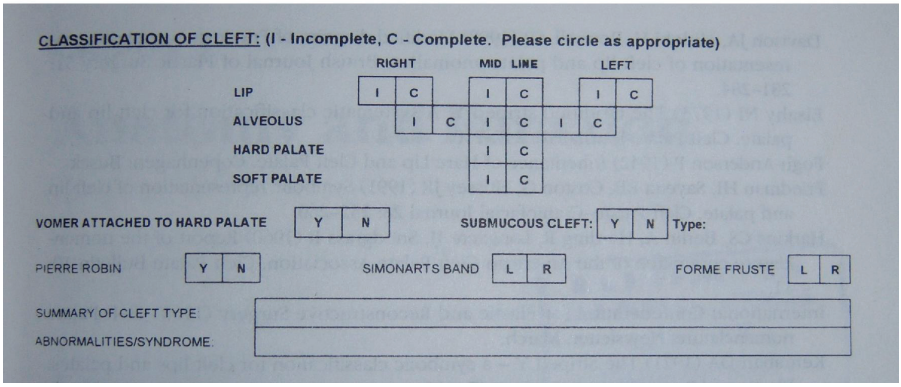
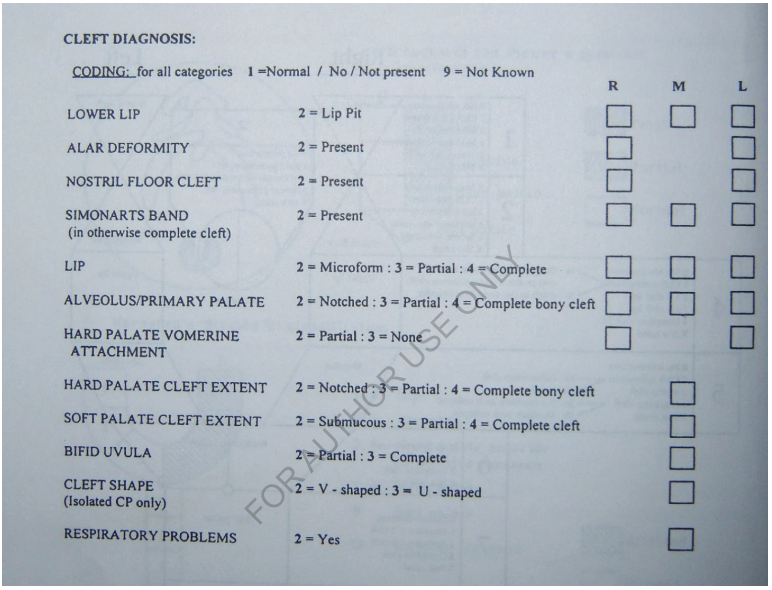
39. CARE classification

Craniofacial Anomalies Register (CARE) classification variation of Stripped Y classification.



40. SCALP symbolic classification

The **S**cottish **C**left **L**ip **A**nd **P**alate group **(SCALP)**



CLEFT DIAGNOSIS:

CODING: for all categories 1 =Normal / No / Not present 9 = Not Known

		R	M	L
LOWER LIP	2 = Lip Pit	☐	☐	☐
ALAR DEFORMITY	2 = Present	☐		☐
NOSTRIL FLOOR CLEFT	2 = Present	☐		☐
SIMONARTS BAND (in otherwise complete cleft)	2 = Present	☐	☐	☐
LIP	2 = Microform : 3 = Partial : 4 = Complete	☐	☐	☐
ALVEOLUS/PRIMARY PALATE	2 = Notched : 3 = Partial : 4 = Complete bony cleft	☐	☐	☐
HARD PALATE VOMERINE ATTACHMENT	2 = Partial : 3 = None	☐		☐
HARD PALATE CLEFT EXTENT	2 = Notched : 3 = Partial : 4 = Complete bony cleft		☐	
SOFT PALATE CLEFT EXTENT	2 = Submucous : 3 = Partial : 4 = Complete cleft		☐	
BIFID UVULA	2 = Partial : 3 = Complete		☐	
CLEFT SHAPE (Isolated CP only)	2 = V - shaped : 3 = U - shaped		☐	
RESPIRATORY PROBLEMS	2 = Yes		☐	

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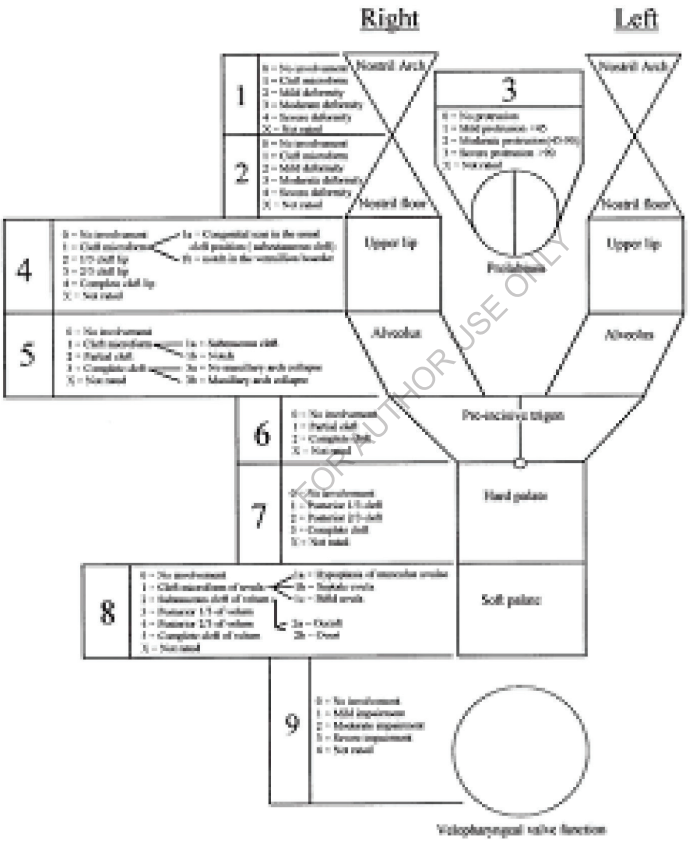
41. Davidson (1998)[38]

A modification of Friedman's system



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42. Posadas (2001)[39]

Posadas et al in **2001** proposed an embryological classification in which he incorporated elements related to palate, lip, and nose that described their complexity from a surgical perspective.

A new method, which allows for a complete description of primary and secondary cleft palates, incorporating elements that are related to the palate, lip, and nose that will also reflect the complexity of this problem. They developed a mathematical expression to characterize clefts of the primary palate, including the magnitude of palatal segment separation and the added complexity of bilateral clefts, yielding a numerical score that reflects overall complexity of the cleft. Clefts of the secondary palate are also considered in a separate score.
Using this method, it is possible to incorporate elements that are not considered in other approaches and to describe all possible clefts that may exist. In the case of cleft primary palate, along with the surgeon, they determined the necessary elements that to be considered are:
1. The complexity of unilateral complete clefts with contact between the primary palate segments (cbs).
2. The separation, in millimeters, in the case of unilateral complete clefts without contact between the primary palate segments (wcbs).
3. The additional complexity associated with bilateral clefts.
Scores associated with the complexity of unilateral complete clefts with cbs are shown . Scores range from 0 (normal primary palate) to 12 (complete cleft of the primary palate with contact between the segments).

FOR AUTHOR USE ONLY

Primary palate	score
Normal	0
Microform	1
Incomplete1/3	3
Incomplete 2/3	6
Complete with contact of segments	12

The degree of separation between the segments in unilateral complete clefts with no cbs was used to establish level of complexity. The relationship between the magnitude of segment separation and complexity was considered to be directly proportional (the greater the separation, the greater the surgical complexity). As such, a separation factor was assigned to each millimeter of separation. From a surgical and aesthetic-functional perspective, the complexity of a bilateral cleft and its repair exceeds the simple summed complexity of the unilateral clefts that form the bilateral cleft. For that reason, bilateral clefts were scored as 1.5 times the sum of the unilateral cleft components. Therefore, in the case of unilateral clefts wcbs, the value 12, corresponding to a complete cleft with contact between the segments (cbs) is multiplied by the factor corresponding to the millimeters of separation between the segments. For example, a complete cleft wcbs (12 mm) has a score of 12 X 2.2 = 26 (rounded off to whole numbers).

Separation in mms	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Factor	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0

As an example of complexity score determination in the case of a bilateral cleft–primary palate with this methodology, consider a bilateral cleft–primary palate with the following characteristics: a left incomplete cleft (one-third) and a right complete cleft, with a 3-mm separation between the segments.

To obtain the overall complexity score:

Calculate the relevance of each unilateral cleft: Left incomplete one-third = 3. Right complete wcbs (3 mm) = 12 X 1.3 = 15.6. Sum unilateral cleft complexities: 3 + 15.6 = 18.6. Multiply the result by the bilateral cleft complexity factor (1.5) i.e.18.6 X 1.5 = 27.9.

A method that fully describes clefts of the primary and secondary palate, taking aesthetic and functional elements such as the features of the cleft itself and the deformity of the lip and nose into account, provides a very valuable tool for the evaluation of progress in the patients' rehabilitation. The advantages of this utility may be seen in the work of Mortier et al (1997), even though their approach is limited to incomplete cleft of the primary palate. Using the method proposed here, all possible cleft forms and their severity can be characterized.

Score Assigned to Secondary Palate Clefts

Secondary Palate	Score
Normal	0
Submucous without bifid uvula (soft palate)	1
Submucous with bifid uvula (soft palate)	4
Incomplete 1/3 central (soft palate only)	8
Incomplete 2/3 unilateral (soft palate 1 one palatal shelf)	13
Incomplete 2/3 bilateral (soft palate 1 both palatal shelves)	14
Complete grade I* unilateral	25
Incomplete 2/3 1 complete grade II†	27
Complete grade I bilateral	28
Complete grade II unilateral	34
Incomplete 2/3 1 complete grade II	36
Complete grade II bilateral	37
Complete grade III‡ unilateral	50
Incomplete 2/3 1 complete grade III	53
Complete grade III bilateral	55

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Examples of the Score Assigned to Some Clefts in the Primary Palate

Description of Cleft		
Left Side	**Right Side**	**Score**
Complete wcs (2 mm)	—	14
Complete wcs (17 mm)	—	32
Incomplete 2/3	Complete wcs (18 mm)	59
Complete wcs (19 mm)	Complete wcs (4 mm)	77
Complete wcs (18 mm)	Complete (18 mm)	100

43. Elnassry (2007)[40]

Elnassry proposed following classification in **2007**. He divided cleft lip and palate patients in to seven classes.

Class I: Unilateral cleft lip
Class II: Unilateral cleft lip and alveolus
Class III: Bilateral cleft lip and alveolus
Class IV: Unilateral complete cleft lip and palate
Class V: Bilateral complete cleft lip and palate
Class VI: Cleft hard palate
Class VII: Bifed uvula

44. LAPAL system (2007)[41]

In **2007** consists of only five Arabic numerals that describe accurate anatomic components and the extent of any cleft. Numerals are ordered from the right side to the left side, corresponding to what one sees when facing a patient. One numeral is used for the palate posterior to the incisive foramen for the following reasons: (1) Clefts in the posterior hard palate and soft palate are almost in the midline; (2) A bilateral cleft palate is not attached to the nasal septum; and (3) The soft palate has no relationship to the Vomer, although a unilateral cleft palate is fused with the nasal septum on one side. The extent of cleft deformities (i.e., intact to complete cleft) is represented by Arabic numerals 0 to 4 in order to provide more detailed information, even though some minor clefts such as a minor degree of cleft alveolus, do not have a great bearing on management. This procedure is consistent with clinical appearances and helps explain the system. The simplicity and precision of the LAPAL system means it is understood easily and can be used for computerized data analysis The LAPAL system has universal application for clinical research and epidemiological investigation.

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Side	Right		Middle	Left	
anatomic component	Lip	Alveolus and Primary palate	Palate	Alveolus and Primary palate	Lip
Complete	4	4	4	4	4
Larger than half	3	3	3	3	3
Smaller than half	2	2	2	2	2
Subcutaneous or Submucous	1	1	1	1	1
Intact	0	0	0	0	0

System for Classification of Cleft Lip and Palate
Qiang Liu et al., Craniofacial Journal, September 2007, Vol.44 No.5, 465-68.

45. Coding [42]

McCabe (1966), Santiago(1969), Schwartz(1993), Ortiz-Posadas(2001), Castilla and Orioli(2004), Liu (2007)

There have been many attempts to code the various types of CLP.

McCabe used electronic data processing system for punching cards.[42] Santiago coded the CLP for machine recording,[16] Schwartz et al. introduced an RPL system for numerical coding with 0-3 numbers to simplify the representation of the clefts,[33] Ortiz-Posadas et al. developed mathematical expression in numerical scores reflecting complexity of clefts,[39] Castilla and Orioli presented ECLAMC system for numeral coding,[43] Liu et al. published five-digit numerical recording system for CLP[41] and many more. However, these methods of classification or coding systems did not gain popularity because of its complexity and difficulty in remembering.

Santiago proposed a classification in 1969 which can be used especially for machine record coding. This classification system consists of digits depending on whether the cleft is present or not and if present, whether it's complete, incomplete or sub mucous. Each digit is followed by letter to describe whether cleft is complete, incomplete or sub mucous. According to Santiago, this classification is encompassing a whole range of defects and by the use of machine coding, data can be retrieved and used for research purposes.

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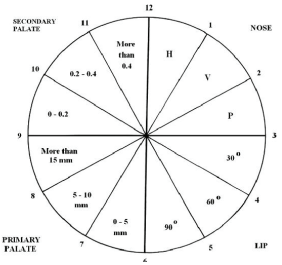
46. Rossell-Perry (2009)[44]

A clock diagram for CLP was introduced by Rossell-Perry, to describe the pathology based on the severity of distortion of nose, lip, and palate. The surgical treatment has been described based on this classification. The author claims to have observed the relationship with the severity and the outcome.



This is a circle divided into four areas, one for each cleft component. Each area is subdivided into three segments, which represent the three degrees of severity: mild, moderate, and severe assign the clock numbers (1 to 12) to each degree of severity of the four components as follows:

a) Right superior quadrant (nasal deformity).

- Degrees: Mild(1), Moderate (2), Severe (3).

b) Right inferior quadrant (medial segment lip and prolabium deformity).

- Degrees: Mild(4), Moderate (5), Severe (6). (The lateral segment lip deficiency is less common than the medial segment deformity, so I include its description in the cleft code—see below.)

c) Left inferior quadrant (primary palate severity).

- Degrees: Mild(7), Moderate (8), Severe (9). (For bilateral clefts, I describe both sides in the diagram.)

d) Left superior quadrant (secondary palate severity).

- Degrees: Mild (10), Moderate (11), Severe (12).

The Cleft Code -

The cleft consists of four numbers, one from each cleft component described on the cleft diagram. These four digit codes are simple to obtain from the clock diagram and provide an accurate description of the severity of the cleft deformity. The sign (*) beside the second number (lip component) indicates that the lateral segment is too short. In bilateral cases, the left side is represented beside the second number (lip component)

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47. Revised Smith-modified Kernahan 'Y' classification (2013)[45]

Incorporates different varieties of the submucous cleft, which can provide an anatomical basis for the severity of velopharyngeal insufficiency.[41]

The submucous cleft palate was denoted by number '7', which is subdivided into four segments (Figure 1);
A. Submucous cleft palate with involvement of the primary hard palate lying anterior to the incisive foramen and posterior to the alveolus (Figure 2).
B. Submucous cleft palate with involvement of the palatine process of the maxillary bone of the secondary hard palate (Figure 3).
C. Submucous cleft palate with involvement of the palatine process of the palatine bone of the secondary hard palate (Figure 4).
D. Submucous cleft of the soft palate including occult submucous cleft palate (Figure 5).

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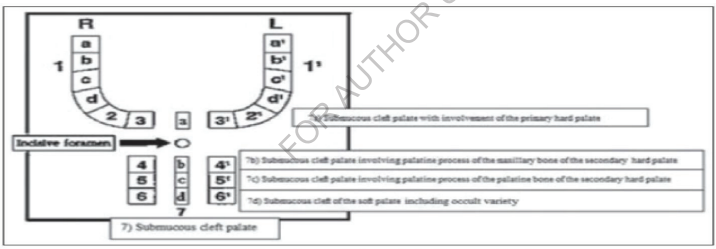

Figure 1) *A revised classification of the cleft lip and palate*

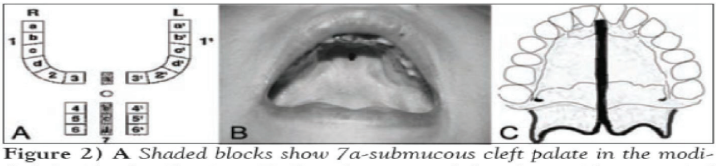

Figure 2) **A** *Shaded blocks show 7a-submucous cleft palate in the modified Smith classification.* **B** *7a-submucous cleft palate with congenital anterior palatal fistula.* **C** *Bold line indicates the extent of involvement in the 7a-submucous cleft palate*

Figure 3) A *Shaded blocks shows 7b-submucous cleft palate in the modified Smith classification.* **B** *7b-submucous cleft palate.* **C** *Bold line indicates the extent of involvement in the 7b-submucous cleft palate*

Figure 4) A *Shaded blocks show 7c-submucous cleft palate in the modified Smith classification.* **B** *7c-submucous cleft palate.* **C** *Bold line indicates the extent of involvement in the 7c-submucous cleft palate*

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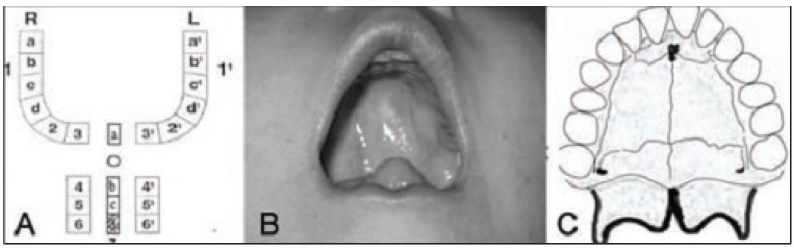

Figure 5) A *Shaded blocks show 7d-submucous cleft palate in the modified Smith classification.* **B** *7d-submucous cleft palate.* **C** *Bold line indicates that only the soft palate is involved in the 7d-submucous cleft palate*

48. Luijsterburg (2014)[46]

Based on the patho-embryology of the primary and secondary palates has been presented by Luijsterburg et al.. The classification is based on the patho-embryological events resulting in various sub-phenotypes of common oral clefts.
Patients within the three categories CL/alveolus (CL/A), CL/A and palate, and CP were divided into three subgroups: Fusion defects, differentiation defects, and fusion and differentiation defects. This classification provides new cleft subgroups that may be used for clinical and fundamental research. [42]

49. International Statistical Classification of Diseases and Related Health Problems (ICD) (2022)[47]

For more than a century, the International Classification of Diseases (ICD) has been the basis for comparable statistics on causes of mortality and morbidity between places and over time. Originating in the 19th century, the latest version of the ICD, ICD-11, was adopted by the 72nd World Health Assembly in 2019 and came into effect on 1st January 2022.

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LA 40: Cleft lip
LA 41: Cleft lip and alveolus
LA 42: Cleft palate
LA 4Y: Other specified clefts of lip, alveolus or palate
LA 4Z: Clefts of lip, alveolus or palate, unspecified

LA 40: Cleft lip

Laterality *(use additional code, if desired)*

- **XK9J**Bilateral
- **XK8G**Left
- **XK9K**Right
- **XK70**Unilateral, unspecified

Associated with *(use additional code, if desired)*

- **LA42**Cleft palate
- **LA42.0**Cleft hard palate
- **LA42.1**Cleft soft palate
- **LA42.2**Cleft uvula

LA 41: Cleft lip and alveolus

Laterality *(use additional code, if desired)*

- **XK9J**Bilateral
- **XK8G**Left
- **XK9K**Right
- **XK70**Unilateral, unspecified

Associated with *(use additional code, if desired)*

- **LA42**Cleft palate
- **LA42.0**Cleft hard palate
- **LA42.1**Cleft soft palate
- **LA42.2**Cleft uvula

LA 42: Cleft palate

Laterality *(use additional code, if desired)*

- **XK9J**Bilateral
- **XK8G**Left
- **XK9K**Right
- **XK70**Unilateral, unspecified

Associated with *(use additional code, if desired)*

- **LA40**Cleft lip
- **LA40.0**Cleft lip, unilateral
- **LA40.1**Cleft lip, bilateral
- **LA40.2**Cleft lip, median
- **LA41**Cleft lip and alveolus
- **LA41.0**Cleft lip and alveolus, unilateral
- **LA41.1**Cleft lip and alveolus, bilateral

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LA 4Y: Other specified clefts of lip, alveolus or palate

- **XK9J**Bilateral
- **XK8G**Left
- **XK9K**Right
- **XK70**Unilateral, unspecified

Specific anatomy *(use additional code, if desired)*

Associated with *(use additional code, if desired)*

- **LA70.1**Bifid nose

LA 4Z: Clefts of lip, alveolus or palate, unspecified

Laterality *(use additional code, if desired)*

- **XK9J**Bilateral
- **XK8G**Left
- **XK9K**Right
- **XK70**Unilateral, unspecified

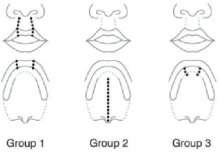
Specific anatomy *(use additional code, if desired)*

Associated with *(use additional code, if desired)*

- **LA70.1**Bifid nose

FOR AUTHOR USE ONLY

Davis and Ritchie



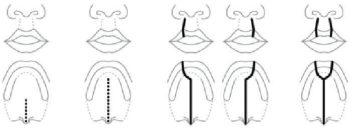
Group 1 Clefts of the lip:
(a) unilateral (incomplete and complete),
(b) bilateral (incomplete and complete)
cleft of the palate may be associated with this group

Group 2 Clefts of the palate:
(a) soft palate, (b) hard palate
cleft of the lip may be associated with this group

Group 3 Clefts of the alveolus:
(a) unilateral (incomplete and complete),
(b) bilateral (incomplete and complete)
clefts of the lip and palate are usually associated with this group

Key
cleft must be present
cleft present at some location

Veau*



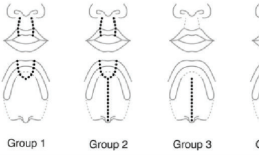
Type I Clefts of the soft palate

Type II Clefts of the soft and hard palate, posterior to the incisive foramen

Type III Complete unilateral cleft alveolus and cleft palate

Type IV Complete bilateral cleft with complete isolation of the median tubercle

Pruzansky



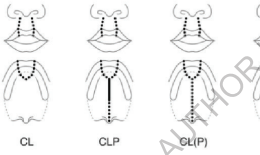
Group 1 Clefts of the lip (and alveolus)

Group 2 Clefts of the lip and palate

Group 3 Clefts of the palate
(includes clefts of the soft palate, clefts of both the soft palate and hard palate, but not the hard palate alone)

Group 4 Congenital insufficiency of the palate
(includes submucous clefts and deficient palatal development)

Ross and Johnston



Primary palatal defects

CL Clefts involving the lip (and alveolus)

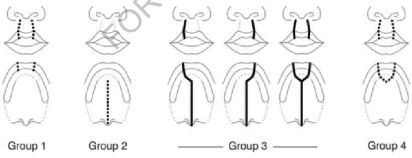
CLP Clefts involving the lip and palate

CL(P) Clefts involving the lip with or without cleft palate

Secondary palatal defects

CP Clefts involving the hard and soft palate only

Iowa system



Group 1 Cleft of the lip only

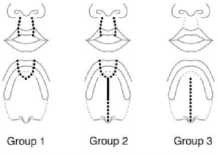
Group 2 Secondary palatal clefts

Group 3 Clefts of the lip, alveolus, and palate (complete cleft lip and palate)

Group 4 Primary cleft palate and lip

Group 5 Miscellaneous

ICPR



Group 1 Clefts of the primary palate:
(a) lip, (b) alveolus

Group 2 Clefts of the primary and secondary palate:
(a) lip, (b) alveolus, (c) hard palate

Group 3 Clefts of the secondary palate:
(a) hard palate, (b) soft palate

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Authors and year	Number of groups/ types	Classification detail	Benefits	Drawbacks	Comments
Davis and Ritchie, 1922	3	Group I: Prealveolar (process) cleft Unilateral/bilateral/median Group II: Postalveolar (process) cleft Soft palate/hard palate Group III: Alveolar (process) cleft Unilateral/bilateral/ median	Started the concept of cleft classification	Not an anatomical classification Lack of clarity Not a versatile one	First classification Has historical importance Not in use
Veau, 1931	4	Group 1: Cleft of soft palate Group 2: Cleft of hard palate Group 3: Complete unilateral CL, alveolus and palate Group 4: Bilateral CL, alveolus and palate	Still in use in modified forms	CL and CL with alveolus not included Sides of the cleft not mentioned No sound developmental basis	
Kernahan and Stark, 1958	2	Cleft of primary palate: Lip and premaxilla, anterior to incisive foramen Cleft of secondary palate: Hard and soft palate, posterior to incisive foramen	Most accepted principle for cleft classification	Not a versatile one Needs more descriptions for combinations	Basis for future classifications
Harkins *et al.*, 1962	6 classes	Cleft of primary palate: A — CL B — Cleft alveolus process Cleft of palate: A — Soft, B — Hard Mandibular process cleft Naso-ocular cleft Oro-ocular cleft Oro-aural cleft	Covers all types of clefts First descriptive classification	Elaborate classification Difficult to remember Did not gain popularity	Appointed by ACPA
Vilar-Sancho, 1962		Clefts were coded "Sk" (skisis) designates cleft "K" (keilos) for lip "G" (gnato) for alveolar process "U" (urano) for hard palate "S" (stafilos) for soft palate "2" for bilateral "d" for right, "I" for left, "I" for incomplete, "o" for operated, "+" for not affected	Objective Flexible Simple Adaptable Detail of cleft can be transcribed	Based on Greek nomenclature Difficult for non-Greek community	
Dahl, 1970	3/4	CL, CP, CLP-UCLP and BCLP	Easy to remember	Combination clefts cannot be classified	Basis for Indian Classification of Balakrishnan, 1975
Spina, 1973	4	Group I: Preincisive foramen cleft Group II: Transincisive foramen cleft Group III: Postincisive foramen clefts Group IV: Rare facial clefts	Simplified version of Harkin's cleft classification	Not popular	Modified ACPA classification, adopted by ISPRS
Berlin, 1979	3	Group 1: Cleft of anterior (primary) palate Group 2: Cleft of anterior and Posterior (secondary) palate Group 3: Cleft of posterior (secondary) palate Rare clefts			Like Spina's classification
Sandham, 1985	5 types	Types 1-4 are like Dahl's classification Type 5: Other types of clefts	Simple, embryologically sound		
Kernahan, 1971 and modifications	Y diagram	Schematic/logo/diagrammatic representation	Mental representation is perfect Ideal for recording the deformity for individual patients	Not fit for verbal communication Computer archiving and retrieval difficult	Not a true descriptive classification
Rossell-Perry, 2009		Clock diagram of 4 segments and 3 subdivisions-Lima clock diagram	Versatile	Diagrammatic representation	Not a true descriptive classification
Present, 2014	3	Combination of descriptive classification with brief notations		There is a learning curve, though short	Based on the Indian Classification of Balakrishnan, 1975

ACPA: American cleft palate association, CL: Cleft lip, CP: Cleft palate, CLP: Cleft lip and palate, UCLP: Unilateral cleft lip and palate, BCLP: Bilateral cleft lip and palate, ISPRS: International society for photogrammetry and remote sensing

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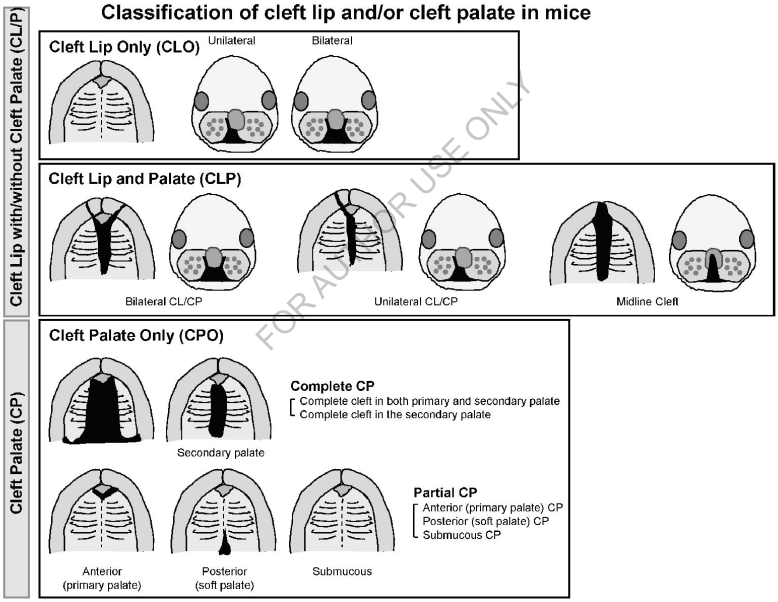
50. Mouse cleft lip and/ or cleft palate

Mouse cleft lip (CL) and/ or cleft palate (CP) is classified into three groups: cleft lip only (CLO; a.k.a. isolated CL), cleft lip with cleft palate (CLP), and cleft palate only (CPO; a.k.a. isolated CP). CLO is further classified into unilateral and bilateral CL, whereas CPO is classified into complete and partial CP. Partial CP is further classified into cleft in the primary palate (anterior region of the palate), cleft in the secondary palate (majority part of the palate), cleft soft palate (posterior region of the palate), and submucous cleft palate (persistence of MEE or incomplete fusion of palatal processes of maxilla). In humans, cleft lip with/ without cleft palate (CL/P) is the most often used term to describe cleft in face. CL/P includes CLO and CLP.



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Conclusion

In addition to the above mentioned classifications, certain other classifications were put forward by **Dorrance** (1946), **Stark** (1954) , **Kernahan** (1958), **Harkins** (1962) and **Whitaker** (1981). Unfortunately, no single system has been universally accepted, and none is universally used. Clinicians often resort to descriptive terms and drawings to provide the specificity required in individual cases. Consequently, unilateral cleft lip and palate (UCLP), Bilateral cleft lip and palate (BCLP), cleft lip (CL), cleft lip and Alveolus (CLA) and cleft palate only (CP) are commonly used connotations to describe the defect.

In deciding on a way of describing clefts it is important to distinguish between two quite separate requirements: there is the need in clinical practice to describe a particular cleft concisely and clearly to one's colleagues, and there is the different need to record the precise details of the deformity for research and audit purposes to allow later comparison of the progress of different groups of patients either within one unit or between different centers.

To fulfil the first requirement the Kernahan and Stark classification is satisfactory, although it may often be best to use terminology that is easily understood.

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However, when recording or reporting a series of cases, there is the need to compare one group or series with another. In some circumstances a very simple grouping is adequate. For example, with references to the two genetically distinct groups of cleft patient the abbreviations CLAP or CL (P) or simply CLP and CP are used. Sometimes the prefix **U** (unilateral) **or 'B'** (bilateral) may be added. In context the meaning is clear in spite of the brevity. It is when more detail is required that the difficulties arise.

The need to build up computerized cleft databases, which are compatible between centers nationally and internationally, has been recognized and steps have already been taken to try to achieve this. Arguments will doubtless persist as to how much detail it is desirable to record, but this should not create problems providing there is general agreement on the basic minimum that is necessary. It seems likely that one of the modern variations of the Striped Y will become the generally accepted way of recording this data.

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